Aug. 4, 1964 D. W. EVANS ETAL 3,143,233

MATERIAL HANDLING APPARATUS

Filed Feb. 7, 1961 3 Sheets-Sheet 1

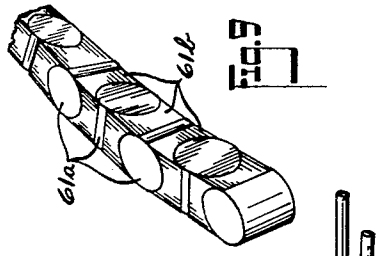


Fig. 9

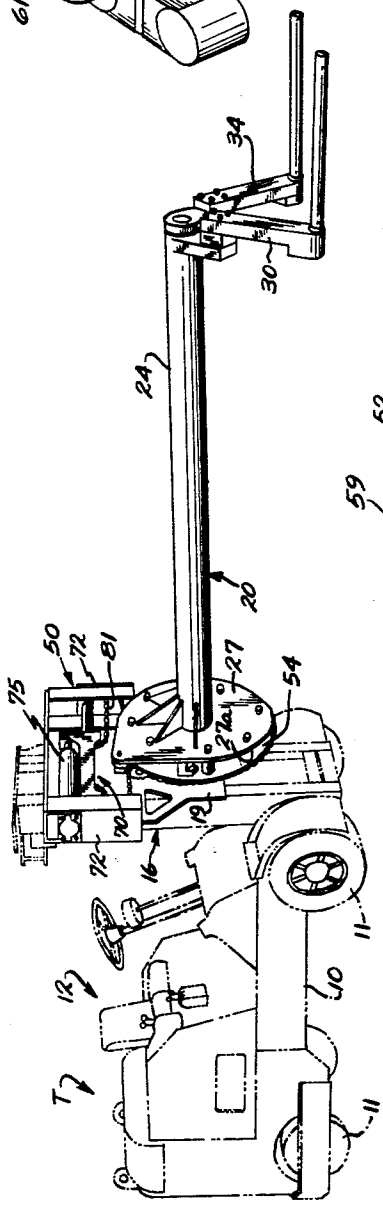


Fig. 1

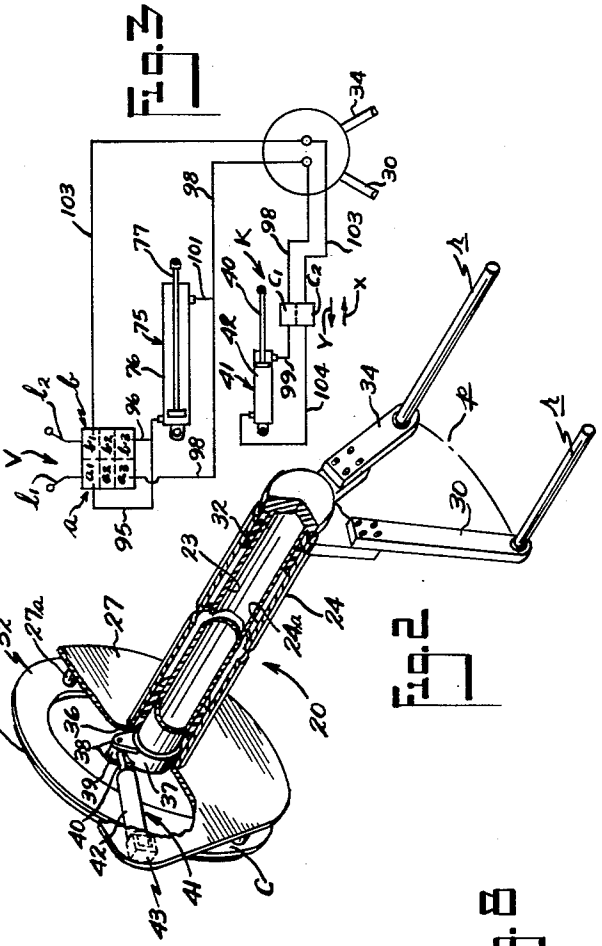


Fig. 2

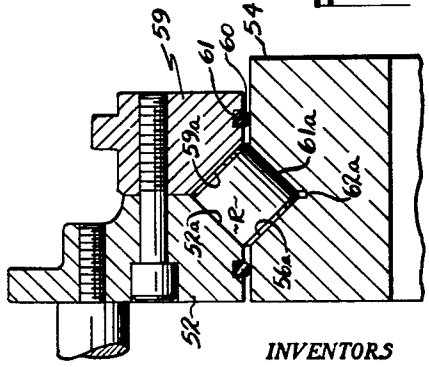


Fig. 8

INVENTORS
DAFYDD WILLIAM EVANS
& ROBERT F. OSTER
BY
Meyer, Baldwin, Dorau & Young
ATTORNEYS

Aug. 4, 1964 D. W. EVANS ETAL 3,143,233

MATERIAL HANDLING APPARATUS

Filed Feb. 7, 1961 3 Sheets-Sheet 2

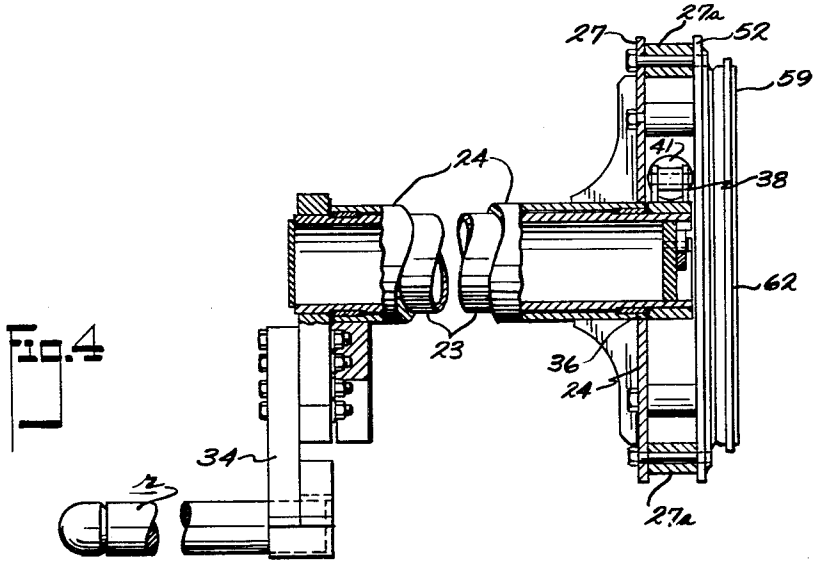


Fig. 4

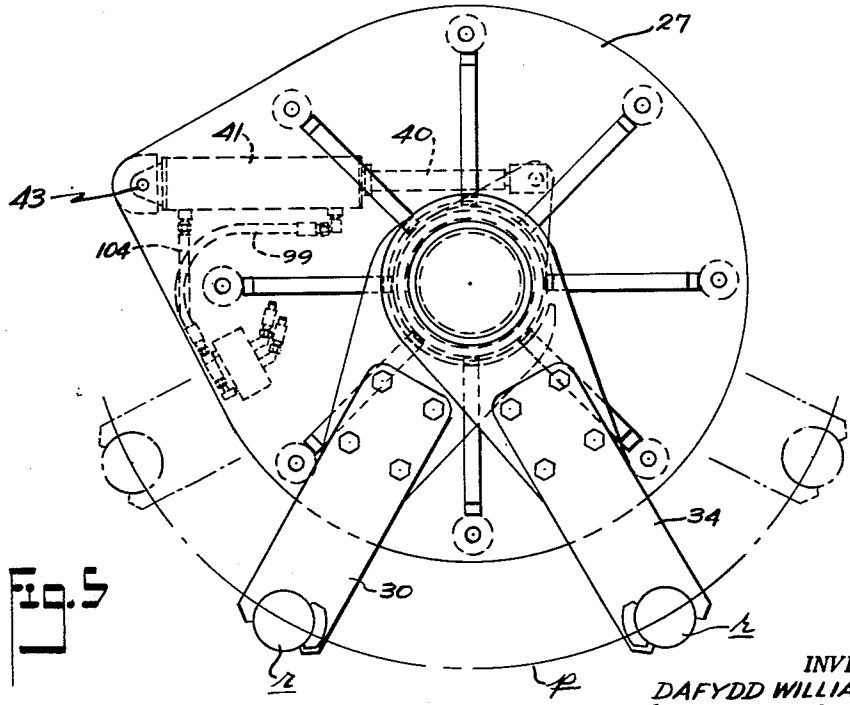


Fig. 5

INVENTORS
DAFYDD WILLIAM EVANS
& ROBERT F. OSTER
BY
Meyer, Baldwin, Dorn & Young
ATTORNEYS

Aug. 4, 1964 D. W. EVANS ETAL 3,143,233

MATERIAL HANDLING APPARATUS

Filed Feb. 7, 1961 3 Sheets-Sheet 3

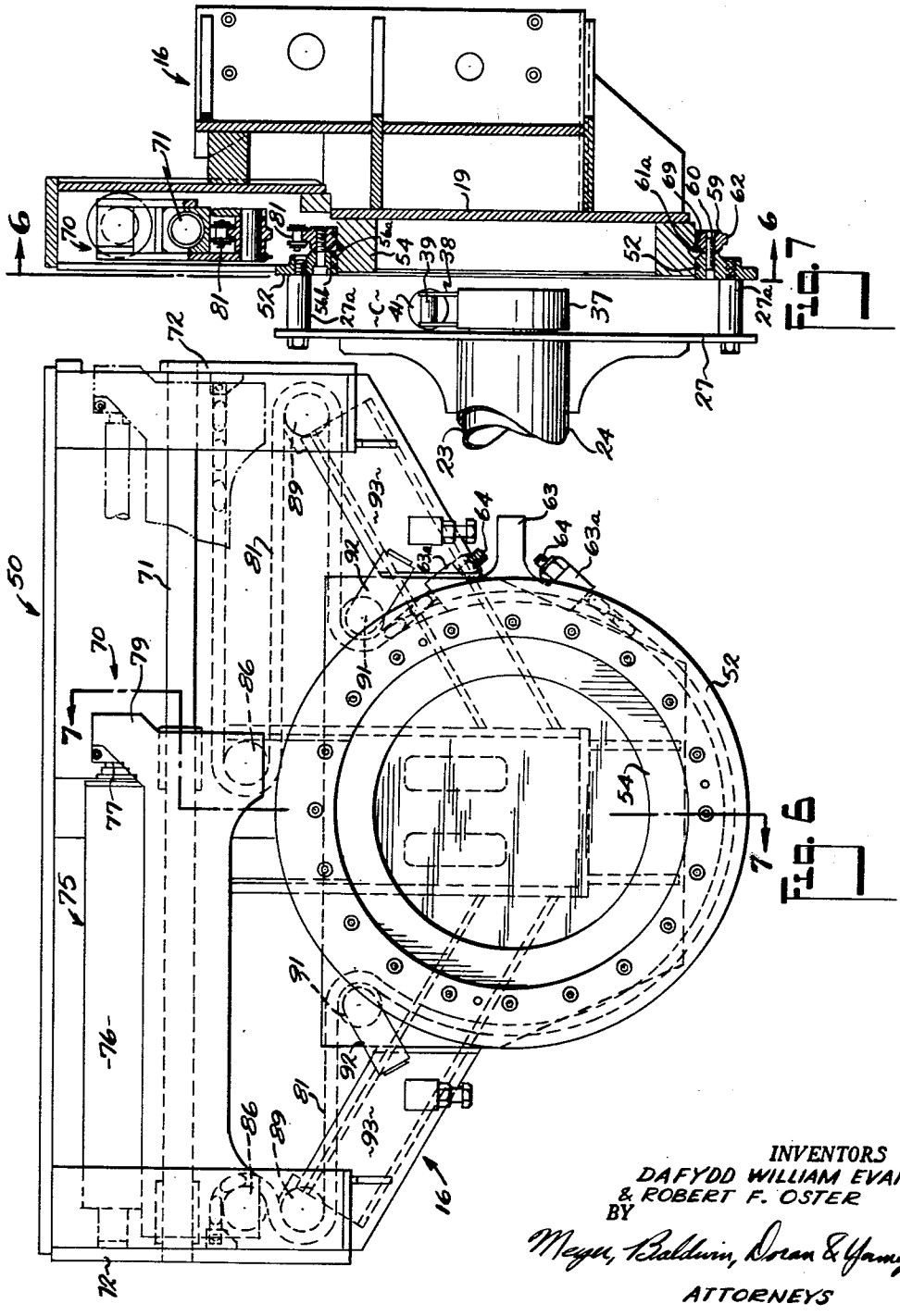


Fig. 7

Fig. 6

INVENTORS
DAFYDD WILLIAM EVANS
& ROBERT F. OSTER
BY
Meyer, Baldwin, Doran & Yaeger
ATTORNEYS

United States Patent Office 3,143,233 Patented Aug. 4, 1964

3,143,233

MATERIAL HANDLING APPARATUS

Dafydd W. Evans, Cleveland Heights, and Robert F. Oster, Rocky River, Ohio, assignors to Towmotor Corporation, Cleveland, Ohio, a corporation of Ohio

Filed Feb. 7, 1961, Ser. No. 87,594
9 Claims. (Cl. 214—652)

This invention relates to novel and improved material handling apparatus and more particularly to apparatus especially designed for use with a mobile vehicle or the like, and which is operable to convey material to and from a work area.

The material handling apparatus of the present invention has particular utility for use with a vehicle generally referred to in the art as an industrial truck, and which is operable in conjunction therewith to transport a material charge to and away from a heating furnace or like chamber.

As will be understood, material charges intended for disposition into a heating furnace or other like chamber are oftentimes deposited in what is commonly referred to as a charging box, or in the alternative said charges are preformed into a billet or ingot of predetermined configuration. Said charge as thus contained and/or preformed is intended to be conveyed to the heating chamber, wherein the contents of said charging box or billet may subsequently be discharged into said chamber.

The material handling apparatus of the present invention is especially designed to automatically accomplish the conveyance of a material charge of the above type, among others, to a heating furnace or like chamber, and to provide for the disposition and discharge of said material charge into said chamber, the several operations of said apparatus being preferably controlled from a position remote from said chamber.

It is therefore a primary object of the present invention to provide novel and improved material handling apparatus especially designed for use with a mobile vehicle, and which is operable to convey a material charge to and from a work area.

Another object of the present invention is the provision of novel and improved material handling apparatus especially designed for use with a mobile vehicle and the like, and which is operable therewith to support and convey a material charge to a heating furnace or like chamber, being thereafter operable to automatically discharge said material charge into said furnace.

Another object of the present invention is the provision of novel and improved material handling apparatus especially designed for use with a mobile vehicle or the like, and which apparatus includes work supporting means for supporting a material charge thereon, said means being adjustably mounted on said vehicle and operable in conjunction therewith to deposit said charge within a heating furnace, said apparatus being likewise adjustable relative to said vehicle so as to discharge said material charge into said heating furnace.

Still another object of the present invention is the provision of novel and approved material handling apparatus especially designed for use with a mobile vehicle and wherein said apparatus includes a pair of tubular members carried one within the other, work supporting means on said tubular members for supporting a material charge therein, said tubular members being adjustably supported on said vehicle and operable therewith so as to be extendable into a heating furnace or like chamber and deposit said charge therein, said tubular members being likewise adjustable relative to each other effective to actuate said work supporting means so as to discharge said material charge into said furnace.

Additional objects and advantages of the material handling apparatus of the present invention will be apparent to one skilled in the art to which it pertains, and upon reference to the following disclosure of a preferred embodiment thereof, and which is illustrated in the accompanying drawings wherein;

FIG. 1 is a perspective view of material handling apparatus embodying the present invention, and which is shown mounted on the front end of an industrial truck;

FIG. 2 is a perspective view of the work handling apparatus embodying the present invention, said apparatus being shown disconnected from its supporting truck;

FIG. 3 is one embodiment of hydraulic control circuit for automatically controlling the several operations of the material handling apparatus of the present invention;

FIG. 4 is a vertical sectional view of the material handling apparatus with external parts partially cut away so as to indicate otherwise hidden parts thereof;

FIG. 5 is a front elevational view of the material handling apparatus taken approximately on the line 6—6 in FIG. 7 and showing the turntable rotating mechanism that is incorporated into the material handling apparatus of the present invention; the turntable and attached work supporting means being removed to more clearly show the underlying structure;

FIG. 6 is a view of the rotating mechanism taken along the line 6—6 of FIG. 7;

FIG. 7 is a fragmentary vertical sectional view taken approximately on the plane as is indicated by the line 7—7 in FIG. 6 with the work supporting means shown attached to the rotating mechanism;

FIG. 8 is a fragmentary vertical sectional view showing one form of bearing assembly for mounting the rotating mechanism on the industrial truck; and,

FIG. 9 is a fragmentary perspective view of several of the bearing elements used in the bearing assembly, said elements being removed from said assembly to more clearly illustrate the construction thereof.

Briefly, the material handling apparatus of the present invention is herein shown, merely for purposes of the instant disclosure, as adapted for use with a vehicle commonly referred to in the art as a self-powered industrial truck, and which is used primarily for transporting material loads in an industrial installation from one work area to another, the instant material handling apparatus being incorporated into said truck assembly and especially designed to transport material charges to and from a heating furnace or like chamber wherein it is desirable as is aforementioned, to automatically deposit said material charges into said furnace from a remote operator's position.

More specifically, the material handling apparatus of the present invention, as adapted for use with said industrial truck, is intended to support a material load while the same is transported to and deposited within said furnace chamber, and is thereafter likewise intended to be automatically operable to discharge said material load from its load supporting apparatus and into said furnace.

Referring now to the drawings throughtout which like elements are designated by the same reference character, the embodiment of work handling apparatus of the present invention is herein shown as adapted for use with an industrial truck, the form of which is generally indicated by the reference character T, and which is somewhat of the type as disclosed in the United States Patent 2,918,143 issued on December 22, 1959, to Walter M. Shaffer. In its present embodiment the truck T is seen to include a vehicle body **10** supported on wheels **11**, said body having an operator's station as is indicated at **12** from which an operator may operate and control the movement of said truck and/or work handling apparatus as will be hereinafter more fully explained.

The instant embodiment of industrial truck T is also seen to have an adjustable work elevating mechanism identified in its entirety by the reference numeral **16**, said mechanism being located preferably at the front end of the said vehicle, being likewise disposed in somewhat of a generally upright position, and intended to be selectively positioned at said location in predetermined elevated positions above the vehicle supporting floor.

The adjustable elevating mechanism **16** is also seen to be provided with a suitable mounting plate **19** extending laterally across the front end of said truck assembly.

The material handling apparatus of the present invention, as is identified in its entirety by the reference numeral **20** is preferably mounted on said mounting plate **19** of said elevating mechanism **16**, being thus adjustably positioned with the same above said supporting floor, and in its present form is seen to include a pair of tubular members identified respectively by the reference numerals **23** and **24**, said tubular members being disposed in telescopic or nested relation one within the other so as to define a tube within a tube assembly.

The outer tubular member **24** of said pair is seen to have its one end rigidly attached preferably by welding or the like to the front face of a turntable **27**, said tubular member preferably projecting outwardly from the latter substantially perpendicularly to the said face of said turntable, said tubular member, in addition, rigidly mounting a work supporting fork **30** at its opposite end.

The inner tubular member **23** is seen to be centrally disposed within the outer tubular member **24**, said members being thus disposed axially about a common axis, the inner tubular member **23** being preferably of substantially smaller diameter and concentrically supported therein in spaced relation to the inner wall **24***a* of said outer tubular member **24** by means of suitable bearings **32**. As will be later apparent, the inner member **23** may be solid, if so desired.

The front end of said inner tubular member **23**, or that remote from the aforesaid turntable **27**, is seen to project forwardly beyond the front end of the outer tubular member **24**, and likewise rigidly mounting a work engaging fork as is identified in its entirety by the reference numeral **34**.

The opposite end of the inner tubular member **23** projects freely rearwardly through an opening **36** formed in said turntable **27**, terminating preferably closely adjacent the rear face thereof and mounts a yoke member as is identified at **37** thereon.

The yoke member **37** is seen to have a pair of spaced arms **38** projecting radially outwardly of the inner tubular member **23**, preferably perpendicularly to the axis thereof and which are connected by a suitable swivel **39** to the free end of piston arm **40** of a suitable fluid motor **41**, the housing **42** of which is likewise swivelly connected as at **43** to said turntable **27**.

With this assembly as thus far described, it is intended that by actuating the said fluid motor **41**, for example so as to propel its piston arm outwardly of its housing **42** or to the right as seen in FIG. 2 the yoke member **37** and attached inner tubular member **23** will be rotated within the outer tubular member **24** in a clockwise direction, said actuation being thus effective to carry the work supporting fork member **34** on the said inner tubular member **23** clockwise through a predetermined arcuate path, the latter being identified at *p*, said form member **34** being thereby moved toward the aforesaid fork member **30** on the outer tubular member **24**. It will likewise be realized that by actuating the said fluid motor **41** so as to cause a counterclockwise rotation of the inner tubular member **23**, the aforesaid work supporting fork **34** thereon will hence be swung counterclockwise through said arcuate path or away from said fork member **30**.

The work supporting fork member **30** carried on the forward end of the outer tubular member **24** is likewise intended to be selectively moved through a similar arcuate path preferably simultaneously with the fork member **34** on the inner tubular member **23** whereby said fork members may be located in preselected spaced relation to each other to one of a plurality of work supporting positions, being thus capable of accommodating various sizes and/or configurations of work loads as will be presently explained in greater detail.

For this purpose, the instant embodiment of material handling apparatus includes a rotating mechanism as is identified in its entirety by the reference numeral **50**, and which is actuatable so as to selectively reversibly rotate the turntable **27**, said turntable actuation being thus effective to rotate the outer tubular member **24** and thereby swing its attached fork member **30** in the manner above mentioned simultaneously with the movement of the fork member **34** on said inner tubular member **23** to thereby locate said fork members in a preselected one of said plurality of work supporting positions.

As will also be later apparent, the present form of rotating mechanism **50** is also intended to be operable so as to reversibly rotate the turntable **27** about its rotational axis sufficiently to swing the fork members from said preselected work supporting position and through an arc of approximately 180 degrees, the purpose for which will be later explained.

As best seen in FIG. 7, the turntable **27** is mounted to the front face of a ring member or apron **52**, being preferably spaced forwardly from the latter by means of suitable bushings **27***a* to thus provide a chamber C for housing the aforesaid fluid motor **41**, said ring member **52** in turn, being rotatably journaled upon the periphery of a hub or spindle **54**, suitable bearing elements are interposed between said spindle and ring member as best seen in FIG. 6, to thus enable said ring member to be freely rotatable about the periphery of said spindle.

The spindle **54** is rigidly attached by suitable means to the front face of the aforementioned mounting plate **19** of the truck's elevating mechanism **16** in such manner so as to project perpendicularly outwardly and forwardly of said mechanism.

Circular chain guide **59** is seen to be disposed over the spindle **54** so as to abut against the rear face of said ring member **52**, said chain guide being likewise securely fastened to the latter by means of bolts **60**. The chain guide **59** is formed on its periphery with a guide way extending circumferentially there-around as is identified by the reference numeral **62**.

The ring member **52** and attached chain guide **59** are rotatably mounted on the spindle **54** by means of a novel bearing assembly capable of accomodating radial, thrust and/or moment loads applied to the instant material handling apparatus.

With reference now directed particularly to FIGS. 8 and 9, the spindle **54** is seen to be formed on its periphery with a groove **56***a* extending circumferentially therearound, and which cooperates with a similar shaped groove formed by the champered edges **52***a* and **59***a* of the ring member **52** and chain guide **59** respectively, to define a closed raceway R of square cross sectional configuration and which extends circumferentially around said spindle, each of said sides of said raceway being preferably inclined at an angle of approximately 45 degrees from a vertical line extending centrally therethrough. Suitable sealing members such as O-rings **60** are disposed in grooves **61** formed on the inner face of ring member **52** and chain guide **59** and are adapted to slidably engage the confronting outer surface of the spindle **54** on either side of the aforesaid spindle groove **56***a* to thus provide a liquid seal therebetween

A plurality of cylindrical bearing elements **61***a* are disposed in said raceway R, adjacent bearing elements being spaced apart by an intervening spacer block **61***b*.

Alternate bearing elements are disposed in said raceway R so that the axes thereof are substantially perpendicular to the axes of the next adjacent bearing ele-

ment on either side thereof. In other words, every other one of the bearing elements 61*a* is disposed in said raceway R so that its axis is substantially perpendicular to the axes of the next adjacent bearing element on either side thereof.

With this assembly it is intended that opposite ends of alternate bearing elements, for example the bearing element 61*a* as viewed in FIG. 8, slidably engage the champered edge 59*a* of the chain guide 59 and the oppositely disposed side of the groove 56*a* in the spindle defining opposite sides of the aforesaid raceway in substantially a surface-to-surface relationship or contact, whereas the opposite ends of the next adjacent bearing element engage the champered edge 52*a* of the ring member 52 and the side of the aforesaid groove 56*a* oppositely disposed thereto in a similar surface to surface contact.

In like manner, the peripheral surface of each bearing element 61*a*, along diametrically opposed and longitudinally extending lines of contact, is intended to engage the remaining two surfaces defining the aforesaid raceway, for example, the peripheral surface of the bearing element viewed in FIG. 8 engages the surfaces 52*a* of the ring member 52 and the oppositely disposed side of the groove 56*a*, said contact being along diametrically opposed lines of contact extending axially along said element, said line contact being likewise substantially perpendicular to the aforesaid surface to surface contact of said bearing element.

As is aforementioned, the bearing elements 61*a* are disposed in said raceway, being preferably equally spaced apart by means of spacer blocks 61*b*. Each of said elements, as thus mounted is intended to be free to rotate about its axes as the ring member 52 is rotated about said spindle 54 in a manner as will be later described while its opposed end surfaces freely slide over the surfaces of said raceway contacted by the same.

As best seen in FIG. 8, a channel 62*a* is preferably provided at the base of the groove 56*a* in the spindle 54, extending circumferentially therearound and through which a suitable lubricant may be applied to the complete bearing assembly.

With this bearing assembly, it will now be realized that the same provides a plurality of bearing surfaces circumferentially spaced about the aforesaid common axes about which the tubular members 23 and 24 are mounted, said surfaces in the instant machine embodiment, each angulating outwardly from said axes at an angle of approximately 45 degrees, said bearing surfaces being thus disposed so as to readily accommodate radial, thrust and/or moment loads applied to said tubular members of said handling apparatus.

The chain guide 59 is also formed on its periphery with an anchor member 63, the latter having a pair of oppositely disposed arms 63*a*, each of which mounts a suitable anchor pin 64.

The instant rotating mechanism 59 is also provided with a dual actuating chain type of translating drive apparatus which is operable with the aforesaid chain guide 59 to thus define a chain drive, said drive being thus intended to translate a reciprocal movement to a rotatable movement effective to reversibly rotatably actuate the turntable 27 about the hub member 54.

As best seen in FIGS. 5 and 6, the drive mechanism includes a carriage member 70 slidably suspended upon a rod 71, preferably approximately directly above the aforementioned spindle 54, in substantial coplanar relation thereto, the ends of said rod being secured within oppositely disposed upstanding plate members 72 attached to the work elevating mechanism 16, said rod thereby extending preferably horizontally therebetween.

A suitable fluid motor 75 is seen to have the closed end of its cylinder 76 attached to one of the aforesaid plate members 72, and the free end of its piston arm 77 securely fastened to an upstanding bracket 79 formed on one end of the aforementioned carriage member 70.

With this assembly, it is intended that by actuating the fluid motor 75, the carriage member 70 may be reciprocally reversibly slidably moved along its supporting rod 71.

The instant drive mechanism also includes a pair of link chains each preferably being identical in length and identified in the present drive assembly by the reference numeral 81, one end of each of said chains being securely fastened to one of the aforementioned plate members 72 and the opposite end thereof being attached to one of the arms 63*a* of the anchor member 63 carried on said ring member 52. Each of said link chains is likewise interconnected to the carriage member 70 whereby upon actuation of the latter in the manner as is above described, said chains cooperate therewith and with said sprocket 59 to translate the reciprocal movement of said carriage member into a rotatable motion effective to selectively rotate said ring member and attached turntable 27.

To accomplish this, the carriage member 70 is seen to rotatably mount a pair of rollers 86, one of which is preferably mounted adjacent each end of said member.

A similar roller 89 is likewise rotatably journaled on each of the aforementioned plate members 72 so as to be spaced below the carriage member 70, said rollers 86 and 89 being preferably disposed so as to be substantially in coplanar relation to the chain guide 59 mounted on the aforesaid hub or spindle 54.

An idler roller 91 rotatably carried within a suitable mounting as is indicated at 92, is likewise seen to be rigidly fastened to each of the support posts 93 forming a part of the aforementioned work elevating mechanism 16 of the industrial truck T, each of said idler sprockets, as thus positioned, being spaced preferably below the adjacent roller 89 and closely adjacent to the chain guide 59 carried on the ring member 52, and also so as to be preferably located above a horizontal line drawn through the axis of said turntable 27. Each of said idler sprockets as thus mounted is likewise preferably disposed in coplanar relation to the aforesaid chain guide 59.

Each of the link chains 81 as is aforementioned, has its one end securely fastened to one of the plate members 72, at a position thereon spaced above the roller 89 carried on the latter as best seen in FIG. 6, and thence extends from said initial end connection inwardly toward the center of the carriage 70, and over and around the roller 86 carried on the adjacent end of said carriage member. Each of said chains is then passed outwardly and over and around the roller 89, carried on the plate member 72 below the aforesaid initial end chain connection, and then inwardly and over and around the idler roller 91 disposed therebelow. The relative location between the rollers 86, 89 and 91 for each chain as thus far described are preferably prearranged so that the various portions or runs of its respective chain extend substantially horizontally therebetween. From said idler roller 91 the aforesaid chain of each assembly is then extended downwardly and around the arcuate portion of the chain guide 59 disposed between said idler roller 91 and the arm 63 of the anchor member 63*a* located at the opposite end of said arcuate portion of said chain guide 59.

With this assembly as is best seen in FIG. 6, the link chains 81 are each partially wrapped around a predetermined arcuate portion of the chain guide 59 in an opposite direction to that of its companion chain.

As will be understood, the chain guide 59 and associated rollers 86, 89 and 91 may be replaced by suitable chain sprockets of similar configuration whereby an equivalent assembly may be obtained.

As is likewise viewed in FIG. 6, it is intended that as the carriage member 70 of the drive assembly is moved to the right from its "piston retracted" position as shown in

solid lines to its "piston extended" position, as is shown in dotted lines, the ring member **52** and attached turntable **27** will be rotated about the spindle **54** in a clockwise direction.

To accomplish this, the ring member **52**, when initially mounted onto the spindle **54**, is rotated thereon so as to locate the anchor member **63** in the approximate position as shown in FIG. 6. With said ring member held in this adjusted position, the link chains **81** are then suspended between their respective roller members as is aforementioned and their respective arcuate portions of the chain guide **59** and then anchored to the arms **63***a* of said anchor member.

Specifically, with said ring member **52** in the instant assembly as thus disposed, the link chain **81** on the left side of the instant drive assembly, as viewed in FIG. 6, is seen to be extended around approximately 200 degrees or at least half the periphery of said chain guide **59**, whereas its companion chain, disposed on the right side of said assembly, extends around approximately 20 degrees or at least one-eighth the periphery of said chain guide, said chain guide portions being spaced one from the other and on opposite sides of said anchor member **63**.

With the ring member **52** in this initial position, the turntable **27** is mounted to the same in the manner as is above described, and the aforesaid fluid motor **41** is prepositioned or actuated so as to locate the fork members **34** and **30** on the inner and outer tubular members **23** and **24** respectively in the position therefor as is shown in solid lines in FIG. 5 wherein each of said fork members is disposed at the lowermost end of its arcuate path *p*, being thus spaced a minimum distance apart and substantially in the same horizontal plane.

From this position, the turntable **27** and the outer tubular member **24** are intended to be rotated in a clockwise direction as viewed in FIG. 5, simultaneously with the counterclockwise rotatable actuation of the inner tubular member **23** to thus swing the fork members **30** and **34** simultaneously in opposite directions along said paths *p* therefor to anyone of a plurality of adjusted positions therealong, the endmost position for each of said fork members being depicted in dotted lines in said reference drawings.

To accomplish this, the fluid motors **41** and **75** are preferably connected into a suitable hydraulic control circuit of conventional design, such as the control circuit as shown in FIG. 3, whereby the actuation of said motors may be controlled by the operator from his remote position at his vehicle station **12**.

With particular reference now directed to FIG. 3, the embodiment of control circuit herein shown is merely one circuit configuration as will be understood by the artisan that is capable of controlling the operation of said fluid motors in the manner intended. Said circuit is specifically seen to comprise a control valve V of conventional design, for example, the control valve manufactured commercially by the Parker Appliance Division of Parker-Hannifin Corporation of Cleveland, Ohio and identified as a "4 plug or stem, 3 position, control valve, No. (VDP2DSDD21D)," only two of said plugs or stations of said valve being herein merely schematically shown, as are identified by the reference characters *a* and *b*, each of said plugs or valve stations having 3 positions identified respectively by a_1, a_2, a_3, and b_1, b_2, b_3. Station a_1 of said valve V is seen to be connected by conduit **95** to one end of the cylinder **76** of fluid motor **75**, said conduit **95**, in turn, being connected in parallel with a conduit **96** communicating with station b_3 of said valve.

Station A_3 of said valve V is likewise connected by conduit **98** to the input side of station c_1 of a suitable double pilot check valve of convention design, such as for example the check valve K manufactured commercially by the Fluid Controls, Inc. of Willoughby, Ohio, and identified by the part No. B58029, said check valve having two valve stations c_1 and c_2, each of which is normally conditioned to permit an output fluid flow in the direction of the arrow *y* and actuatable to an operated position effective to permit an output fluid flow in the direction as indicated by the arrow *x*. Conduit **99** connects the output side of valve station c_1 to one end of the cylinder **42** of motor **41**. Said conduit **98** is also seen to be connected in parallel with conduit **101** communicating with the opposite end of the aforesaid motor cylinder **76**.

The station b_1 of said valve V is similarly connected in series by conduit **103** to the input side of valve station c_2 of said check valve K, the output end thereof being connected through conduit **104** to the opposite end of the cylinder **42**.

The piston rod **40** of fluid motor **41** is shown in its "extended position" so that the fork member **34** is in its innermost position as shown in FIG. 5, whereas the piston rod **77** of fluid motor **71** is in its "retracted position" so that the carriage member **70** and hence the turntable **27** is likewise positioned at the aforesaid initial position therefor to thus dispose the fork member **30** also in its innermost position.

The valve stations a_1 to a_3 are actuated by lever l_1 whereas valve stations b_1 to b_3 are actuated by lever l_2. Each of said valve stations a_2 and b_2 is the neutral position for each of said stations.

To provide for the simultaneous movement of said fork members **30** and **34** to a preselected one of said adjusted positions therefor, the control circuit is operated in the following manner.

The lever l_2 of the control valve V is operated so as to connect the conduit **96** through valve station b_3 to the fluid source whereby the cylinder **76** is energized to propel its piston rod **77** to the right, and slide the carriage in the same direction which, as heretofore mentioned, causes the turntable **27** to partake of a clockwise rotation as viewed in FIG. 6 which is also effective to swing the fork member **30** upwardly and away from the fork member **34**.

As seen in FIG. 3, the opposite end of the cylinder **76** is connected by conduits **101**, **98**, valve station *c* of the check valve K and conduit **99** to the right end of the cylinder **42** so that as the piston rod **77** of said motor **75** begins to move to the right, the portion of said cylinder **76** ahead of said rod is bled through said conduits and check valve into said cylinder **42**. Consequently, the latter cylinder is also simultaneously energized so as to retract its piston rod **40** to the left with a consequent counterclockwise swinging of the fork member **34** upwardly and away from the aforesaid fork member **30**. As will be understood, the left end of the cylinder **76** is permitted to bleed through conduit **104**, valve station c_2 of the check valve K, conduit **103** and valve station b_1 to the sump of the fluid source.

Since the inner tubular member **23** is also carried in a clockwise direction with the turntable **27**, the operational characteristics of the fluid motors **41** and **75** are preferably selected so that the linear velocity of the piston rod **40** is approximately double the linear velocity of the piston rod **77** so that the inner tubular member **23** will be rotated counterclockwise by said piston rod **40** at a sufficient velocity as to move the fork members at approximately the same velocity away from each other and to maintain the same in substatntial horizontal spaced relation during the interval of adjustment therefor.

In this manner, the inner and outer tubular members **23** and **24**, as thus disposed in said nested relation, may be selectively rotatably actuated so as to locate the work supporting fork members **34** and **30**, respectively, in predetermined horizontal spaced relation to each other so as to accommodate the disposition of a material charge thereon preparatory to conveying the same to the aforementioned heating furnace. As seen particularly in FIG. 2, each of the fork members is provided with an outwardly projecting rod *r* which is adapted to accommo-

date the charging box and/or material billet thereon or other selected configuration of material charge to thus facilitate carrying said charge to said heating furnace.

Although not herein shown in detail, it is intended that when the fork members **30** and **34** have been raised to their respective adjusted postions to thus accommodate the material load thereon the lever l_2 of the valve V is returnable to its neutral position (valve station b_2) effective to disconnect the conduit **96** from the fluid source and to lock the fluid motors **41** and **75** in their adjusted positions. As will also be understood, the check valve K connected between the cylinders **41** and **75** is effective to prevent fluid leaking between said cylinders which may cause the fork members **30** and **34** to gradually seek incorrect positions after the valve is returned to its said neutral position.

With the material load supported on the fork members **30** and **34**, the elevating mechanism **16** may then be adjusted, if so desired, to raise and/or lower the supported charge to a desirable height above the supporting floor after which the vehicle T is thus caused to convey the same to the heating furnace or chamber whereby the tubular members **23** and **24** are extended partially into said chamber so as to discharge said load therein.

In the case where the material load is contained within the aforementioned charging box it is required that said box be inverted so as to empty the contents thereof into said chamber.

To accomplish this, the operator actuates lever l_1 of the control valve V so as to connect the conduit **95** through station a_1 to the fluid source whereby the cylinder **76** is energized to again propel its piston rod **77** to the right, as viewed in FIGS. 3 and 6, which is effective to cause the translating drive mechanism to rotate the turntable **27** in the same direction in the manner as is above described and hence to swing the fork members **30** and **34** through an additional arc of approximately 180 degrees sufficiently to invert said charging box, and thus discharge the contents therefrom. During this interval, the opposite end of the cylinder **76** is connected through conduits **98** and **101** and valve station a_3 to the sump of the fluid source.

To return the turntable **27** and fork members **30** and **34** to their initial position such as for example the position therefor shown in FIG. 1, the operator actuates lever l_2 of the valve V so as to connect the series conduit **103** through valve station b_1 to the fluid source which is effective to reversibly energize the cylinder **42** of the fluid motor **41** and hence cause the piston rod **40** thereof to be extended to the right as viewed in FIGS. 2 and 3. As a result, the inner tubular member **23** is rotated within the outer tubular member **24** in a clockwise direction to thus swing the fork member **34** toward its companion fork member **30** on said outer tubular member **24**.

Simultaneously with the energization of cylinder **42**, the cylinder **76** is also reversibly energized through conduits **99**, **98** and **101** interconnecting said cylinders **42** and **76** in series relation. As a result, the piston arm **77** is retracted which, in turn, slides the carriage **70** to the left, as viewed in FIG 6, so as to provide a counterclockwise rotation to the turntable **27** and attached tubular members **23** and **24** so that the fork member **30** is also swung toward its companion fork member **34**, whereby the same are returned to the aforementioned initial position therefor. Lever l_1 of said control valve V is then actuated to connect its valve station a_2 and conduit **98** to the fluid source which is effective to cause a continual retraction of the piston rod **77** whereby the turntable **27** is returned to its initial position.

In the event the material charge supported on the fork members **30** and **34** is in the form of an ingot or billet having, for example, a T-shaped configuration whereby said fork members are adjusted, so as to underlie the cross bar of said ingot and the elevating mechanism **16** of the truck T is then raised so as to support said ingot in a raised position while the same is deposited into the heating chamber, the fork members **30** and **34** may also be required to be further separated so as to permit the ingot to fall therebetween. As will also be realized, the turntable **27** may also be rotated, if necessary, in the manner just described to a position whereby the ingot is inverted sufficiently so that it will slide from between said supporting fork members and into said chamber.

Since the turntable **27** is first rotated in a clockwise direction so as to swing the fork member **30** through its arcuate path *p* for positioning the same in preselected spaced relation to its companion fork member **34**, and thereafter is again rotated in a clockwise direction to cause the inverting of the charging box or like container for discharging the contents thereon into said heating chamber, it will be apparent that the instant translating drive mechanism **50** is intended to be operable so as to reversibly rotate the turntable **27** through approximately 220 degrees.

Although the instant translating drive mechanism provides approximately 220 degrees of rotational actuation to the turntable **27**, it is apparent that the several components of said mechanism may be prepositioned upon their assembly so that the same will provide any preselected rotational actuation, for example 90 degrees of rotation for said turntable.

It may also be desirable to rotate the turntable **27** in the opposite direction for inverting the fork members **30** and **34**. This may be accomplished by rotating the ring member **52** approximately 180° in a clockwise direction from the position therefor as shown in FIG. 6 to thus locate the anchor member **63** on the left side of the spindle **54** and thereafter actuating the fluid motor **75** to extend its piston rod **77** and move the carriage **70** to the right side of its supporting rod, said position being thus the "initial" position therefor. Thereafter, the link chains **81** may be inter-connected to said carriage and ring member **52** in the same manner as is above described whereby upon actuating the fluid motor **75** so as to cause the retraction of its piston rod **77** and movement of the carriage **70** to the left, the ring member **52** and attached turntable **27** will be rotated in a counterclockwise direction which is opposite to that previously described.

Other changes, combinations and/or arrangements of the several components of the instant material handling apparatus will be apparent to one skilled in the art to which it pertains, said modifications as will be understood being within the scope of the inventive concepts hereof as are defined in the appended claims.

What is claimed is:

1. in combination, a vehicle having a generally upright carrier plate, material handling apparatus comprising a turntable rotatably supported on said plate, a pair of telescopically related members carried on said turntable so as to extend generally horizontally outwardly from said vehicle, load supporting means on each of said members for supporting a load thereon, first drive means connected to said turntable and actuatable to rotate said turntable and said members effective to swing said load supporting means on said members in one direction through a predetermined arcuate path, second drive means connected to one of said members and actuatable to rotate said one member relative to the other of said telescopically related members effective to swing the load supporting means on said one member in the opposite direction through a predetermined arcuate path, control means for controlling the actuation of said first and second drive means whereby the load supporting means in each of said members swings away from each other to a load supporting position, and said first drive means being subsequently actuatable to rotate said turntable and telescopically related members effective to swing said load supporting means through an additional arcuate path in said one direction to a load discharging position.

2. Material handling apparatus in combination with a vehicle as is defined in claim 1 and wherein the control means is operable to control the actuation of the first and second drive means such that the load supporting means on each of said members swing away from each other at substantiallly the same velocity.

3. Material handling apparatus in combination with a vehicle as is defined in claim 1 and wherein the first drive means includes a carriage movably supported on the vehicle, means interconnecting said carriage and said turntable, and means for moving said carriage to effect the rotation of said turntable and telescopically related members.

4. Material handling apparatus in combination with a vehicle as is defined in claim 3 and wherein the means interconnecting said carriage and turntable comprises flexible chain means interconnected to said turntable and carriage and operable to effect reversible rotation of said turntable in response to a reversible actuation of said carriage.

5. Material handling apparatus in combination with a vehicle as is defined in claim 4 and wherein the first drive means includes a reversible fluid motor drivingly connected to said carriage.

6. Material handling apparatus in combination with a vehicle as is defined in claim 4 and wherein the second drive means includes a reversible fluid motor drivingly connected to said one telescopically related member.

7. In combination, a vehicle having a generally upright carrier plate, material handling apparatus comprising a turntable rotatably supported on said plate, a pair of telescopically related tubular members carried on said turntable so as to extend generally horizontally outwardly from said vehicle, a load supporting arm attached to the free end of each of said tubular members and extending outwardly therefrom, a carriage slidably mounted on said vehicle, flexible chain means interconnecting said carriage and said turntable, first motor means for slidably moving said carriage to effect a consequent rotation of said turntable and tubular members and swing said arms in one direction through a predetermined arcuate path, second motor means for rotating one of said tubular members relative to the other of said tubular members effective to swing the load supporting arm on said one member in the opposite direction through a predetermined arcuate path, control means in circuit with said first and second motor means for controlling the actuation thereof such that the load supporting arms on said tubular members swing away from each other at substantially the same velocity to a load supporting position, and said first motor means being subsequently operable to rotate said turntable and tubular members effective to swing said load supporting arms through an additional arcuate path in said one direction to a load discharging position.

8. Material handling apparatus in combination with a vehicle as is defined in claim 7 and wherein the first motor means is interconnected between the carriage and carrier plate.

9. Material handling apparatus in combination with a vehicle as is defined in claim 7 and wherein the second motor means is interconnected between the inner member of said telescopically pair of related members and said turntable.

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